

1      **CLAIMS**

2      1. A processor-readable medium comprising processor-executable  
3      instructions for:

4            sending test data to a plurality of clients;  
5            receiving a rate  $R_i$  which is based at least in part on a rate at which the test  
6      data was received by at least some of the plurality of clients; and  
7            calculating a rate  $R_0$  at which to send an image to the plurality of clients,  
8      wherein the rate  $R_0$  is a function of at least some of the  $R_i$ .

9  
10     2. The processor-readable medium as recited in claim 1, wherein  
11    sending test data comprises instructions for sending test data to the plurality of  
12    clients by operation of a reliable multicast session.

13  
14     3. The processor-readable medium as recited in claim 1, wherein  
15    sending test data comprises instructions for:

16            sending an initial transmission of test data;  
17            setting a timer; and  
18            sending additional test data until the timer expires.

19  
20     4. The processor-readable medium as recited in claim 1, wherein  
21    sending test data comprises instructions for sending a portion of the image at an  
22    initial transfer rate.

1       5. The processor-readable medium as recited in claim 1, wherein  
2 sending test data comprises instructions for:

3             sending a first portion of the image at a first rate; and

4             sending a second portion of the image at a second rate.

5  
6        6. The processor-readable medium as recited in claim 1, wherein  
7 sending test data comprises instructions for varying an amount of test data sent to  
8 balance reliability and cost.

9  
10      7. The processor-readable medium as recited in claim 1, wherein  
11 receiving the rate  $R_i$  comprises instructions for receiving a UDP packet from the at  
12 least some of the plurality of clients.

13  
14      8. The processor-readable medium as recited in claim 1, wherein  
15 receiving the rate  $R_i$  comprises instructions for receiving data-transfer statistics  
16 from the at least some of the plurality of clients.

1       9. The processor-readable medium as recited in claim 1, wherein  
2 receiving the rate  $R_i$  comprises instructions for:

3             setting a timer to indicate a maximum period of time during which to wait  
4 for a response from the plurality of clients; and

5             receiving data-transfer statistics from the at least some of the plurality of  
6 clients within the maximum period.

7  
8       10. The processor-readable medium as recited in claim 1, wherein  
9 calculating the rate  $R_0$  comprises instructions for setting  $R_0$  as a function of a  
10 minimal value of the rate  $R_i$  for all i.

11  
12      11. The processor-readable medium as recited in claim 1, wherein  
13 calculating the rate  $R_0$  comprises instructions for:

14             dividing the plurality of clients into at least two groups; and  
15             setting  $R_0$  equal to a minimum  $R_i$  associated with clients within one of the at  
16 least two groups.

17  
18      12. The processor-readable medium as recited in claim 1, wherein  
19 calculating the rate  $R_0$  comprises instructions for:

20             selecting one of the  $R_i$ ; and  
21             setting  $R_0$  equal to the selected  $R_i$ , less a de-rating factor.

1       **13.** The processor-readable medium as recited in claim 12, wherein  
2 selecting one of the  $R_i$  comprises instructions for:

3             forming at least two groups of clients; and  
4             selecting the smallest  $R_i$  associated with a client from within the at least two  
5 groups of clients.

6  
7       **14.** The processor-readable medium as recited in claim 1, additionally  
8 comprising instructions for sending the image at the rate  $R_0$  during a first multicast  
9 session.

10  
11      **15.** The processor-readable medium as recited in claim 14, additionally  
12 comprising instructions for:

13             opening a second multicast session; and  
14             sending the image at a rate less than  $R_0$  in the second multicast session.

15  
16      **16.** A processor-readable medium comprising processor-executable  
17 instructions for:

18             receiving test data from a server;  
19             calculating a value for  $R_i$  based at least in part on a rate at which the test  
20 data was received; and  
21             sending the rate  $R_i$  to the server.

22  
23      **17.** The processor-readable medium as recited in claim 16, wherein the  
24 test data was received during a reliable multicast session.  
25

1       **18.** The processor-readable medium as recited in claim 16, wherein  
2 receiving the test data comprises instructions for:

3             receiving an initial transmission of test data;  
4             setting a timer; and  
5             receiving additional test data until the timer expires.

6

7       **19.** The processor-readable medium as recited in claim 16, wherein  
8 receiving the test data comprises instructions for receiving a portion of the image  
9 at an initial transfer rate.

10

11      **20.** The processor-readable medium as recited in claim 16, wherein  
12 receiving the test data comprises instructions for:

13             decrypting and decompressing the initial transmission of test data; and  
14             writing the decrypted and decompressed test data to a disk.

15

16      **21.** The processor-readable medium as recited in claim 16, wherein  
17 sending the  $R_i$  comprises instructions for sending a UDP packet to the server.

18

19      **22.** The processor-readable medium as recited in claim 16, wherein  
20 sending the rate  $R_i$  comprises instructions for sending data-transfer statistics  
21 including the rate  $R_i$  to the server in a UDP packet.

22

23      **23.** The processor-readable medium as recited in claim 16, wherein  
24 calculating the rate  $R_i$  comprises instructions for setting the rate  $R_i$  equal to an  
25 average rate at which data was received.

1  
2       **24.** The processor-readable medium as recited in claim 16, wherein  
3 calculating the rate  $R_i$  comprises instructions for setting rate  $R_i$  equal to a  
4 minimum rate at which data was received.  
5

6       **25.** The processor-readable medium as recited in claim 16, wherein  
7 calculating the rate  $R_i$  comprises instructions for:  
8             setting the rate  $R_i$  as a function of the rate at which data was received; and  
9             de-rating the rate  $R_i$  to result in a safer value.  
10

11       **26.** The processor-readable medium as recited in claim 16, additionally  
12 comprising instructions for receiving an image at a rate  $R_0$  during a first multicast  
13 session if  $R_0$  is less than  $R_i$ .  
14

15       **27.** The processor-readable medium as recited in claim 26, additionally  
16 comprising instructions for receiving the image during a second multicast session  
17 if  $R_0$  is more than  $R_i$ .  
18  
19  
20  
21  
22  
23  
24  
25

1       **28.** A method for determining a transfer rate to multicast an image,  
2 comprising:  
3             sending test data from a server to a plurality of clients;

4             calculating  $R_i$  values for at least some of the plurality of clients based at  
5 least in part on rate of receipt of the test date;

6             sending the  $R_i$  values from each of the plurality of clients to the server; and

7             calculating a rate  $R_0$  at which to send an image from the server to the  
8 plurality of clients, wherein the rate  $R_0$  is a function based at least in part on at  
9 least some of the  $R_i$  values.

10  
11       **29.** The method as recited in claim 28, wherein the test data is sent over  
12 a reliable multicast session.

13  
14       **30.** The method as recited in claim 28, wherein sending test data  
15 comprises:

16             sending an initial transmission of test data from the server;

17             setting a timer on the server;

18             receiving the initial transmission of the test data on each client;

19             setting a timer on each client;

20             sending additional test data until the timer on the server expires.

21  
22       **31.** The method as recited in claim 28, wherein sending test data  
23 comprises sending a portion of the image at an initial transfer rate.

1       **32.** The method as recited in claim 28, wherein sending test data  
2 comprises:

3             sending a first portion of the image at a first rate; and

4             sending a second portion of the image at a second rate.

5

6       **33.** The method as recited in claim 28, wherein the test data is:

7             a selected percentage of the image;

8             a selected amount of data obtained from the image; or

9             data obtained from the image of a size calculated for transmission within a  
10 selected period of time.

11

12       **34.** The method as recited in claim 28, wherein the  $R_i$  values are sent  
13 from at least some of the plurality of clients to the server via a UDP packet.

14

15       **35.** The method as recited in claim 28, wherein sending  $R_i$  values  
16 comprises:

17             setting a timer on the server to indicate a maximum period of time during  
18 which the server will wait for a response from the plurality of clients; and  
19             transferring data-transfer statistics from the plurality of clients to the server  
20 within the maximum period.

21

22       **36.** The method as recited in claim 28, wherein calculating the rate  $R_0$   
23 comprises setting the rate  $R_0$  equal to a minimum of the  $R_i$  values for all i.

1       **37.** The method as recited in claim 28, wherein calculating the  $R_0$   
2 comprises:  
3              dividing the plurality of clients into at least two groups; and  
4              setting  $R_0$  as a function of a minimum  $R_i$  associated with clients within one  
5 of the at least two groups.  
6

7       **38.** The method as recited in claim 28, wherein calculating the  $R_0$   
8 comprises:  
9              selecting one of the  $R_i$ ; and  
10             setting  $R_0$  as a function of the selected  $R_i$ , less a de-rating factor.  
11

12       **39.** The method as recited in claim 28, wherein calculating the rate  $R_0$   
13 comprises:  
14              forming at least two groups of clients, wherein the forming is based on the  
15  $R_i$ 's of the clients;  
16              selecting a smallest  $R_i$  associated with a client from within the at least two  
17 groups of clients; and  
18              setting  $R_0$  as a function of the selected smallest  $R_i$ .  
19

20       **40.** The method as recited in claim 28, additionally comprising sending  
21 the image at the rate  $R_0$  during a first multicast session.  
22

23       **41.** The method as recited in claim 40, additionally comprising:  
24              opening a second reliable multicast session; and  
25              sending in the second multicast session at a rate less than  $R_0$ .

1       **42.**   A server, comprising:

2              means for sending test data to a plurality of clients, wherein the test data is a  
3              subset of an image to be sent to the plurality of clients;

4              means for receiving a rate  $R_i$  based at least in part on a rate at which the test  
5              data was received by at least one of the plurality of clients; and

6              means for calculating a rate  $R_0$  at which to send the image to the plurality of  
7              clients, wherein the rate  $R_0$  is a function of the  $R_i$ .

8

9       **43.**   The server as recited in claim 42, wherein the means for sending test  
10     data comprises means for operating a reliable multicast session.

11

12       **44.**   The server as recited in claim 42, wherein the means for calculating  
13     the  $R_0$  comprises means for setting the rate  $R_0$  equal to a minimum value of the  
14     rate  $R_i$  for all i.

15

16       **45.**   The server as recited in claim 42, wherein the means for calculating  
17     the  $R_0$  comprises:

18              means for dividing the plurality of clients into at least two groups; and  
19              means for setting  $R_0$  equal to a minimum  $R_i$  associated with clients within  
20     one of the at least two groups.

1           **46.**   The server as recited in claim 42, wherein the means for sending test  
2 data is configured to send:

3                 a selected percentage of the image;  
4                 a selected amount of data obtained from the image; or  
5                 data obtained from the image of a size calculated for transmission within a  
6 selected period of time.

7  
8           **47.**   The server as recited in claim 42, additionally comprising means for  
9 sending the image at the rate  $R_0$  during a first multicast session.

10  
11          **48.**   The server as recited in claim 42, wherein the means for receiving  
12 the rate  $R_i$  comprises:

13                 means for setting a timer to indicate a maximum period of time during  
14 which to wait for a response from the plurality of clients; and

15                 means for receiving data-transfer statistics from the at least some of the  
16 plurality of clients within the maximum period.

17  
18          **49.**   The server as recited in claim 42, wherein the means for sending test  
19 data comprises means for setting a timer to indicate a maximum period of time  
20 during which to send the test data to the plurality of clients

1       **50.** A client, comprising:

2           means for receiving test data from a server during a reliable multicast

3 session, comprising:

4           means for receiving an initial transmission of test data comprising a  
5 portion of an image at an initial transfer rate;

6           means for setting a timer; and

7           means for receiving additional test data until the timer expires;

8           means for calculating a rate  $R_i$  based at least in part on a rate at which the  
9 test data was received; and

10          means for sending the rate  $R_i$  to the server.

11  
12       **51.** The client as recited in claim 50, wherein the means for receiving  
13 test data additionally comprises:

14          means for decrypting and decompressing the received test data; and

15          means for writing the decrypted and decompressed test data to a disk.

16  
17       **52.** The client as recited in claim 50, wherein the means for sending the  
18 rate  $R_i$  comprises means for sending data-transfer statistics including the rate  $R_i$  to  
19 the server in a UDP packet.

20  
21  
22  
23  
24  
25

1       **53.**   The client as recited in claim 50, wherein the means for calculating  
2 the  $R_i$  comprises means for setting  $R_i$  equal to an average rate at which the test data  
3 was received.

4

5       **54.**   The client as recited in claim 50, wherein the means for calculating  
6 the rate  $R_i$  comprises means for setting the rate  $R_i$  equal to a minimum rate at  
7 which the test data was received.

8

9       **55.**   The client as recited in claim 50, wherein the means for calculating  
10 the  $R_i$  comprises:

11              means for setting the rate  $R_i$  as a function of a rate at which the test data  
12 was received; and

13              means for de-rating the rate  $R_i$  to result in a safer value.

14

15       **56.**   The client as recited in claim 50, additionally comprising means for  
16 receiving the image at a rate  $R_0$  during a first multicast session if the rate  $R_0$  is less  
17 than the rate  $R_i$ .

18

19       **57.**   The client as recited in claim 50, additionally comprising instructions  
20 for means for allowing the client to receive the image during a second multicast  
21 session if the rate  $R_0$  is more than the rate  $R_i$ .

1       **58.** A server, comprising:

2              a test data generation module to generate test data for transmission to a  
3              plurality of clients, wherein the test data is a subset of an image to be sent to the  
4              plurality of clients; and

5              an  $R_0$  calculation module to receive a rate  $R_i$  at which the test data was  
6              received by at least some of the plurality of clients and to calculate a rate  $R_0$  at  
7              which to send the image to the plurality of clients, wherein the rate  $R_0$  is a function  
8              of the rate  $R_i$ .

9

10       **59.** The server as recited in claim 58, wherein the test generation module  
11              is configured to send the test data to the plurality of clients by operation of a  
12              reliable multicast session.

13

14       **60.** The server as recited in claim 58, wherein the  $R_0$  calculation module  
15              is configured to set the rate  $R_0$  equal to a minimum value of the rate  $R_i$  for all i.

16

17       **61.** The server as recited in claim 58, wherein the  $R_0$  calculation module  
18              is additionally configured to:

19              divide the plurality of clients into at least two groups; and  
20              set the rate  $R_0$  equal to a minimal value of the rate  $R_i$  associated with clients  
21              within one of the at least two groups.

1       **62.** The server as recited in claim 58, wherein the test data generation  
2 module is configured to send:

3              a selected percentage of the image;  
4              a selected amount of data obtained from the image; or  
5              data obtained from the image of a size calculated for transmission within a  
6 selected period of time.

7

8       **63.** The server as recited in claim 58, additionally comprising:

9              a data communication module configured to set a timer to indicate a  
10 maximum period of time during which to wait for receipt of data-transfer statistics  
11 from the plurality of clients.

12

13       **64.** A client, comprising:

14              a data reception module to receive test data from a server during a reliable  
15 multicast session, wherein the test data reception module is additionally configured  
16 to:

17                  receive an initial transmission of test data comprising a portion of an  
18                  image at an initial transfer rate;

19                  set a timer; and  
20                  receive additional test data until the timer expires;  
21              an  $R_i$  calculation module to calculate a rate  $R_i$  based at least in part on a rate  
22 at which the test data was received; and

23              an  $R_i$  management module to transmit the rate  $R_i$  to the server.

1       **65.**   The client as recited in claim 64, wherein the data reception module  
2 is additionally configured for:

3              decrypting and decompressing the received test data; and  
4              writing the decrypted and decompressed test data to a disk.

5

6       **66.**   The client as recited in claim 64, wherein the  $R_i$  management module  
7 transmits the rate  $R_i$  via a UDP packet to the server.

8

9       **67.**   The client as recited in claim 64, wherein the  $R_i$  calculation module  
10 is configured to set the rate  $R_i$  equal to an average rate at which the test data was  
11 received.

12

13      **68.**   The client as recited in claim 64, wherein the  $R_i$  calculation module  
14 is configured to set the rate  $R_i$  equal to a minimum rate at which the test data was  
15 received.

16

17      **70.**   The client as recited in claim 64, wherein the  $R_i$  calculation module  
18 is configured to set the rate  $R_i$  as a function of a rate at which data was received  
19 and to de-rate the rate  $R_i$  to result in a safer value.

20

21      **71.**   The client as recited in claim 64, wherein the data reception module  
22 is configured to receive the image at a rate  $R_0$  during a first multicast session if  $R_0$   
23 is less than  $R_i$ .

1       **72.** The client as recited in claim 64, wherein the data reception module  
2 is configured to receive the image during a second multicast session if  $R_0$  is more  
3 than  $R_i$ .

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25